

Claims

1 1. In a method of encoding a digital video
2 image stream in an encoder, comprising spatial
3 compression of still images in the digital video
4 image stream and temporal compression between the
5 still images, wherein the spatial compression is
6 carried out by converting a time domain image of a
7 macroblock to a frequency domain image of the
8 macroblock, taking the discrete cosine transform of
9 the frequency domain image, transforming the discrete
10 cosine transformed macroblock image by a quantization
11 factor, and run length encoding the quantized
12 discrete cosine transformed macroblock image, wherein
13 the temporal compression is carried out by
14 reconstructing the run length encoded, quantized,
15 discrete cosine transformed image of the macroblock,
16 searching for a best match macroblock, and
17 constructing a motion vector therebetween, to thereby
18 form a bitstream comprising run length encoded,
19 quantized, discrete cosine transformed macroblocks
20 and motion vectors, and passing the bitstream to and
21 through an external buffer to a transmission medium,
22 the improvement comprising feeding back to the
23 encoder an external buffer read signal from the host
24 and incrementing an on-chip counter each time that
25 the external buffer is read and calculating therefrom
26 the number of bits read by the host (R), and
27 determining the number of bits encoded and written
28 into the external buffer (E), and in the encoder
29 subtracting from the number of bits encoded (E) the
30 number of bits read by the host (R) to give the
31 fullness of the external buffer (BF), and providing
32 from the encoder to the host a dynamic buffer level

33 indicator in real time indicative of the fullness of
34 the external buffer (BF).

1 2. The method of claim 1, wherein said
2 providing the host with said dynamic buffer level
3 indicator comprises comparing the fullness of the
4 external buffer (BF) with a buffer threshold (BT)
5 defined by said host and providing a high-level
6 indicator when the buffer fullness (BF) is greater
7 than the buffer threshold (BT), and a low-level
8 indicator when the buffer threshold (BT) is greater
9 than the buffer fullness (BF).

1 3. The method of claim 2, further comprising
2 retaining said buffer threshold (BT) in a register
3 within the encoder for use in said comparing of
4 buffer fullness (BF) to the host-defined buffer
5 ~~threshold (BT).~~

1 4. The method of claim 1, further comprising
2 providing an external buffer configuration register
3 in said encoder for retaining multiple external
4 buffer configuration values, and wherein said
5 calculating in the encoder the number of bits read by
6 the host (R) includes employing a predefined
7 configuration value of the external buffer
8 configuration register in determining the number of
9 bits read by the host (R) upon receipt of each buffer
10 read signal from the host.

1 5. The method of claim 4, wherein said
2 multiple external buffer configuration values
3 retained in said external buffer configuration
4 register comprise at least some of 1, 2, 4 and 8 byte
5 buffer configuration values, each value being
6 representative of a number of bytes read from said
7 external buffer with each buffer read signal from the
8 host for a respective external buffer configuration.

1 6. The method of claim 1, wherein said
2 external buffer comprises a FIFO buffer and said
3 encoder comprises an MPEG-2 video encoder.

1 7. The method of claim 1, wherein said
2 external buffer comprises one of a field buffer or
3 cascaded FIFO buffers, and wherein said dynamic
4 buffer level indicator comprises at least one of a
5 BUFFER_EMPTY flag, BUFFER_ALMOST_FULL flag and
6 BUFFER_FULL flag.

1 8. The method of claim 1, wherein said
2 providing the host in real time with said dynamic
3 buffer level indicator comprises providing the host
4 in real time with multiple dynamically updated flags,
5 said multiple dynamically updated flags comprising a
6 BUFFER_EMPTY flag, BUFFER_ALMOST_FULL flag and
7 BUFFER_FULL flag.

1 9. In a method of encoding a digital video
2 image stream in an encoder, comprising spatial
3 compression of still images in the digital video
4 image stream and temporal compression between the
5 still images, wherein the spatial compression is
6 carried out by converting a time domain image of a
7 macroblock to a frequency domain image of the
8 macroblock, taking the discrete cosine transform of
9 the frequency domain image, transforming the discrete
10 cosine transformed macroblock image by a quantization
11 factor, and run length encoding the quantized
12 discrete cosine transformed macroblock image, wherein
13 the temporal compression is carried out by
14 reconstructing the run length encoded, quantized,
15 discrete cosine transformed image of the macroblock,
16 searching for a best match macroblock, and
17 constructing a motion vector therebetween, to thereby
18 form a bitstream comprising run length encoded,
19 quantized, discrete cosine transformed macroblocks
20 and motion vectors, and passing the bitstream to and
21 through an external buffer to a transmission medium,
22 the improvement comprising feeding back to the
23 encoder an external read signal from the host and
24 incrementing an on-chip counter each time that the
25 external buffer is read and calculating therefrom the
26 number of bits read by the host (R), and determining
27 the number of bits encoded and written into the
28 external buffer (E), and in the encoder subtracting
29 from the number of bits encoded (E) the number of
30 bits read by the host (R) to give the fullness of the
31 external buffer (BF), and providing from the encoder
32 to the host in real time a dynamically updated flag
33 comprising at least one of a BUFFER_EMPTY flag, a
34 BUFFER_ALMOST_FULL flag and a BUFFER_FULL flag.

1 10. The method of claim 9, wherein said
2 providing the host in real time with said dynamically
3 updated flag comprises providing the host in real
4 time with at least said BUFFER_EMPTY flag, said
5 providing of said BUFFER_EMPTY flag comprising
6 continuously determining whether said fullness of the
7 external buffer (BF) is equal to 0, and providing a
8 high-level indicator when the buffer fullness (BF) is
9 0, and a low-level indicator when the buffer fullness
10 is greater than 0.

1 11. The method of claim 9, wherein said
2 providing the host in real time with said dynamically
3 updated flag comprises providing the host with at
4 least said BUFFER_ALMOST_FULL flag, said providing of
5 said BUFFER_ALMOST_FULL flag comprising continuously
6 determining whether the fullness of the external
7 buffer (BF) is greater than or equal to a buffer
8 threshold (BT), and providing said host with a high-
9 level indicator when the buffer fullness (BF) is
10 greater than or equal to said buffer threshold (BT),
11 and a low-level indicator when the buffer threshold
12 (BT) is greater than the buffer fullness (BF).

1 12. The method of claim 11, further comprising
2 providing an on-chip buffer threshold register, said
3 on-chip buffer threshold register containing a host
4 defined buffer threshold value for use in said
5 comparing of said buffer fullness (BF) to said buffer
6 ~~threshold (BT).~~

1 13. The method of claim 9, wherein said
2 providing the host in real time with said dynamically
3 updated flag comprises providing the host in real
4 time with at least said BUFFER_FULL flag, said
5 providing of said BUFFER_FULL flag, comprising
6 continuously comparing the fullness of the external
7 buffer (BF) to a predefined buffer size (BS), and
8 providing the host with a high-level indicator when
9 the buffer fullness (BF) is greater than or equal to
10 said buffer size (BS), and a low-level indicator when
11 said buffer size (BS) is greater than said buffer
12 fullness (BF).

1 14. The method of claim 13, further comprising
2 providing an on-chip buffer size register for holding
3 a host-defined buffer size value for use in said
4 comparing of said buffer fullness (BF) to said buffer
5 size (BS).

1 15. The method of claim 9, wherein said
2 external buffer comprises one of an external field
3 buffer or external cascaded FIFOs.

1 16. An encoder for encoding a digital video
2 image stream in the encoder, comprising means for
3 spatial compression of still images in the digital
4 video image stream and means for temporal compression
5 between the still images, wherein the means for
6 spatial compression comprises means for converting a
7 time domain image of a macroblock to a frequency
8 domain image of the macroblock, means for taking the
9 discrete cosine transform of the frequency domain
10 image, means for transforming the discrete cosine
11 transformed macroblock image by a quantization
12 factor, and means for run length encoding the
13 quantized discrete cosine transformed macroblock
14 image, wherein the means for temporal compression
15 comprises means for reconstructing the run length
16 encoded, quantized, discrete cosine transformed image
17 of the macroblock, means for searching for a best
18 match macroblock, and means for constructing a motion
19 vector therebetween, said means for encoding a
20 digital video image stream thereby forming a
21 bitstream comprising run length encoded, quantized,
22 discrete cosine transform macroblocks and motion
23 vectors and passing the bitstream to and through an
24 external buffer to a transmission medium, the
25 improvement comprising means for feeding back to the
26 encoder an external read signal from the host, and
27 logic in the encoder for incrementing an on-chip
28 counter each time that the external buffer is read
29 and calculating therefrom the number of bits read by
30 the host (R), said logic in the encoder being further
31 adapted to monitor the number of bits encoded (E) and
32 written into the external buffer and subtract from
33 the number of bits encoded (E) the number of bits
34 read by the host (R) to obtain the fullness of the

35 external buffer (BF), and wherein said logic in the
36 encoder is further adapted to provide the host with a
37 dynamic buffer level indicator in real time
38 indicative of the fullness of the external buffer
39 (BF).

1 17. The encoder of claim 16, wherein said logic
2 adapted to provide the host with a dynamic buffer
3 level indicator comprises logic adapted to compare
4 the fullness of the external buffer (BF) with a
5 buffer threshold (BT) defined by said host and to
6 provide a high-level indicator when the buffer
7 fullness (BF) is greater than the buffer threshold
8 (BT), and a low-level indicator when the buffer
9 threshold (BT) is greater than the buffer fullness
10 (BF).

1 18. The encoder of claim 17, further comprising
2 a buffer threshold (BT) register within the encoder
3 coupled to said logic adapted to compare said buffer
4 fullness (BF) to the host-defined buffer threshold
5 (BT).

1 19. The encoder of claim 16, wherein said
2 external buffer comprises at least one FIFO buffer
3 and said encoder comprises an MPEG-2 video encoder.

1 20. The encoder of claim 16, wherein said
2 external buffer comprises one of a field buffer or
3 cascaded FIFO buffers, and wherein said dynamic
4 buffer level indicator comprises at least one of a
5 BUFFER_EMPTY flag, BUFFER_ALMOST_FULL flag and
6 BUFFER_FULL flag.

Sub A5

1 21. The encoder of claim 20, wherein said
2 dynamic buffer level indicator comprises said
3 BUFFER_EMPTY flag, and wherein said logic is further
4 adapted to continuously determine whether said
5 fullness of the external buffer (BF) is equal to 0,
6 and provide a high-level indicator when the buffer
7 fullness (BF) is 0, and a low-level indicator when
8 the buffer fullness is greater than 0.

1 22. The encoder of claim 20, wherein said
2 dynamic buffer level indicator comprises said
3 BUFFER_ALMOST_FULL flag, and wherein said logic is
4 further adapted to continuously determine whether the
5 fullness of the external buffer (BF) is greater than
6 or equal to a buffer threshold (BT), and to provide
7 said host with a high-level indicator when the buffer
8 fullness (BF) is greater than or equal to said buffer
9 threshold (BT), and a low-level indicator when the
10 buffer threshold (BT) is greater than the buffer
11 ~~fullness (BF).~~

1 23. The encoder of claim 22, further comprising
2 an on-chip buffer threshold register, said on-chip
3 buffer threshold register containing a host defined
4 buffer threshold value for use by said logic in
5 comparing said buffer fullness (BF) to said buffer
6 threshold.

Sub A6

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1 24. The encoder of claim 20, wherein said
2 dynamic buffer level indicator comprises said
3 BUFFER_FULL flag, and wherein said logic is adapted
4 to continuously compare the fullness of the external
5 buffer (BF) to a predefined buffer size (BS), and to
6 provide the host with a high-level indicator when the
7 buffer fullness (BF) is greater than or equal to said
8 buffer size (BS), and a low-level indicator when said
9 buffer size (BS) is greater than said buffer fullness
10 ~~(BF).~~

1 25. The encoder of claim 24, further comprising
2 an on-chip buffer size register within said encoder
3 for holding a host-defined buffer size value for use
4 by said encoder logic in comparing said buffer
5 fullness (BF) to said buffer size (BS).

1 26. The encoder of claim 20, wherein said
2 external buffer comprises one of an external field
3 buffer or external cascaded FIFOs.

1 27. An encoder for encoding a digital video
2 image stream in the encoder, comprising means for
3 spatial compression of still images in the digital
4 video image stream and means for temporal compression
5 between the still images, wherein the means for
6 spatial compression comprises means for converting a
7 time domain image of a macroblock to a frequency
8 domain image of the macroblock, means for taking the
9 discrete cosine transform of the frequency domain
10 image, means for transforming the discrete cosine
11 transformed macroblock image by a quantization
12 factor, and means for run length encoding the
13 quantized discrete cosine transformed macroblock
14 image, wherein the means for temporal compression
15 comprises means for reconstructing the run length
16 encoded, quantized, discrete cosine transformed image
17 of the macroblock, means for searching for a best
18 match macroblock, and means for constructing a motion
19 vector therebetween, said means for encoding a
20 digital video image stream thereby forming a
21 bitstream comprising run length encoded, quantized,
22 discrete cosine transform macroblocks and motion
23 vectors and passing the bitstream to and through an
24 external buffer to a transmission medium, the
25 improvement comprising means for feeding back to the
26 encoder an external read signal from the host, and
27 on-chip logic in the encoder for incrementing an on-
28 chip counter each time the external buffer is read
29 and calculating therefrom the number of bits read by
30 the host (R), said logic in the encoder being further
31 adapted to monitor the number of bits encoded (E) and
32 written into the external buffer and subtract from
33 the number of bits encoded (E) the number of bits
34 read by the host (R) to obtain the fullness of the

35 external buffer (BF), and wherein said logic in the
36 encoder is further adapted to provide the host in
37 real time with dynamically updated flags comprising a
38 BUFFER_EMPTY flag, a BUFFER_ALMOST_FULL flag and a
39 BUFFER_FULL flag.

1 28. The encoder of claim 27, wherein said
2 external buffer comprises one of an external field
3 buffer or external cascaded FIFOs.

1 29. The encoder of claim 28, wherein said logic
2 adapted to provide said BUFFER_EMPTY flag comprises
3 logic adapted to continuously determine whether said
4 fullness of the external buffer (BF) is equal to 0,
5 and to provide a high-level indicator when the buffer
6 fullness (BF) is 0, and a low-level indicator when
7 the buffer fullness is greater than 0.

1 30. The encoder of claim 29, wherein said logic
2 adapted to provide said BUFFER_ALMOST_FULL flag
3 comprises logic adapted to continuously determine
4 whether the fullness of the external buffer (BF) is
5 greater than or equal to a buffer threshold (BT), and
6 to provide said host with a high-level indicator when
7 the buffer fullness (BF) is greater than or equal to
8 said buffer threshold (BT), and a low-level indicator
9 when the buffer threshold (BT) is greater than the
10 buffer fullness (BF).

1 31. The encoder of claim 30, wherein said logic
2 adapted to provide said BUFFER_FULL flag comprises
3 logic adapted to continuously compare the fullness of
4 the external buffer (BF) to a predefined buffer size
5 (BS), and to provide the host with a high-level
6 indicator when the buffer fullness (BF) is greater
7 than or equal to said buffer size (BS), and a low-
8 level indicator when said buffer size (BS) is greater
9 than said buffer fullness (BF).

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